DOCUMENT RESUME

ED 129 865 TM 005 662

AUTHOR Loadman, William E.
TITLE Identifying the Characteristics of the Ideal Professor: An Application of Multidimensional Scaling.
PUB DATE Apr 76
NOTE 19p.; Paper presented at the Annual Meeting of the National Council on Measurement in Education (60th, San Francisco, California, April 19-23, 1976)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Administrator Attitudes; College Faculty; College Instruction; College Students; Comparative Analysis; Criteria; Data Collection; *Effective Teaching; Evaluation Criteria; *Higher Education; Individual Characteristics; Interprofessional Relationship; *Multidimensional Scaling; *Nonparametric Statistics; *Professors; Student Attitudes; Teacher Attitudes; *Teacher Characteristics

ABSTRACT

A nonmetric multidimensional scaling technique was employed to determine the characteristics of the ideal professor. Subsequently, the results were compared across varying levels of program personnel, including administrators, faculty, staff and students. Centered in a relatively self-contained academic program of a large midwestern university, this study used a free response method of data collection--a relatively unknown technique. Consistent differences were found among various levels of personnel as to their perception of the ideal faculty member. In addition, the procedure provided a means of comparing the perceived performance of individual faculty members. In general, the data seemed to indicate that subgroups of personnel were operating from what appeared to be a consistent frame of reference, but that they rationalized the characteristics somewhat differently. Moreover, the perceptions were not consistent among groups. These discrepancies might result in role expectations which might go unfulfilled or overfulfilled, causing probable miscommunication and lack of efficiency, affecting the morale of involved personnel. Internal conflict could also be a possibility. (MV)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED129865

IDENTIFYING THE CHARACTERISTICS OF THE IDEAL PROFESSOR: AN APPLICATION OF MULTIDIMENSIONAL SCALING

PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Wm E. Loadman
TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE NATIONAL INSTITUTE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER.

William E. Loadman
The Nisonger Center
The Ohio State University

Prepared for 1976 Annual Program Meeting
of National Council on Measurement in Education

April 1976

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

TM005 662

Draft Document--not to be quoted without permission of author

IDENTIFYING THE CHARACTERISTICS OF THE IDEAL PROFESSOR: AN APPLICATION OF MULTIDIMENSIONAL SCALING[1]

William E. Loadman
The Nisonger Center
The Ohio State University

The purpose of this inquiry was to determine the applicability of a non-metric multidimensional scaling technique in identifying the characteristics of the ideal professor. A subsequent purpose was to compare the results of the technique across varying levels of program personnel. Personnel levels included administrators, faculty, staff and students from a relatively self contained academic program in a large midwestern university. A free response method of data collection was employed and this study presents the procedures and findings associated with the use of this relatively unknown technique. Consistent differences were found among various levels of personnel as to their perception of the ideal and various faculty members. This procedure also demonstrated a means of comparing the perceived performance of individual faculty members.

BACKGROUND

A problem which consistently confronts university administrators and program personnel is identifying the criteria or characteristics which can be used as standards by which an individual's performance can be assessed. To date, many of these efforts have relied upon (1) a rational selection by program administrators, (2) a factor analytic study identifying relevant dimensions or characteristics, (3) peer evaluation or (4) implicit non-specific criteria (Astin and Lee, 1966; Costin, Greenough, and Menages, 1971; Wilson, Dienst, and Watson, 1973). Multidimensional scaling has been suggested as an alternative procedure for the identification of these characteristics.

---

[1] The author wishes to acknowledge the assistance of Ann Ruedele and Mary Kim for their efforts in this study.

Subkoviak and Levin (1974) used a non-metric multidimensional scaling procedure to ascertain the characteristics of an ideal professor using faculty members from a given university department. They found that the procedure could be invoked in a meaningful way and does discriminate among individuals. Kruskal (1964, 1969) developed a scaling procedure which utilizes ordinal level data based on multiple responses and reduces the input using a non-metric procedure to a number of dimensions. Shepard (1962), Carroll and Chang (1964), and Carroll (1972) indicate the feasibility of utilizing non-metric multidimensional scaling as a procedure for assessing distance among rated stimuli.

Using Subkoviak and Levin's model of non-metric multidimensional scaling, this inquiry attempted to determine the characteristics of an ideal professor from the criteria generated by various levels of program personnel. It also examined the similarities and discrepancies of various levels of staff as to their perceptions of individual faculty members with respect to these ideal characteristics. Finally, it attempted to replicate a study by Subkoviak and Levin (1974) which used only one level of respondents.

METHODOLOGY

The specific methodology used in this study can be separated into the categories of subjects, instrumentation, data collection and data reduction; a discussion of each category follows.

Subjects

Each instrument was completed by 43 individuals from a specific, relatively self contained academic program in a large midwestern university. There were five administrators, fifteen faculty members, fifteen staff members and eight students completing the instrument. All individuals were associated with the program and familiar with the faculty members.

Instrumentation

An open ended method of data collection was used in this study. An instrument was designed to allow each respondent to first list the characteristics important in describing the ideal professor and to subsequently define the relative importance of each by appropriately dividing the total of 100 points among the various characteristics, the largest number of points being assigned to the most important characteristic, etc. Each characteristic listed had to receive at least one point and the sum of points for a given respondent had to total 100.

Once the ideal characteristics and concomitant weights were individually established, the respondents were instructed to use each characteristic which they identified and create a unidimensional scale on that characteristic with a minimum of two and maximum of five points on a continuum. The determination of the continuum was left to the discretion of the individual. For example, it might have been: high, medium, and low; good, bad; frequently, infrequently; high intensity, moderate intensity, low intensity, very low intensity; etc. This procedure was repeated for each characteristic identified by the individual respondent.

Data Collection

After individually creating the characteristics, weight, and concomitant unidimensional scales, the respondents were given an enumerated list of 26 faculty members in the program and were instructed to sort the faculty members, one characteristic at a time, into the various categories on their scale. In addition, they were instructed to place the ideal professor into the scale category which they thought was most appropriate. This process was repeated for each characteristic the respondent identified.

Data Reduction

Since each individual respondent identified a unique set of characteristics and a unique scale for each characteristic, it was necessary to use a methodological procedure which would allow the data to be put in a common metric for comparative purposes. This was achieved through the application of a non-metric multidimensional scaling procedure (Kruskal and Carmone, 1969). One large advantage of the non-metric multidimensional scaling procedure is that the procedure has been demonstrated to function very adequately when the number of respondents is equal to or less than the number of stimuli. Obviously the greater number of respondents the greater the stability of the procedure.

Using a procedure similar to that used by Wish, Deutsch and Biener (1970) and Subkoviak and Levin (1974), similarity indices were constructed for all possible pairs of the 27 rated individuals (26 faculty members plus the ideal). Each similarity index ranged in value from .00, indicative of a low similarity rating, to 1.0, the highest possible similarity rating. Specifics of the index development are discussed below.

One hundred percent of the instruments (43) were returned and for each of the k respondents (instruments), the measure of similarity between each pair (i and j) of the 26 faculty members and the ideal professor was computed. For a given respondent, the similarity index between faculty members i and j (summed across categories) is defined as: $(S_{ij})_k = \sum_{c=1}^{M_k} W_c (a_{ij})_c$

where M_k = the number of characteristics of the ideal professor determined by the respondent (k)

W_c = weight (.01 to 1.0) determined by respondent (k) for characteristic C

$(a_{ij})_c$ = 1 if faculty members i and j sorted into same scale category by respondent (k) with respect to characteristic C

= 0 if faculty members i and j sorted into different scale categories by respondents (k) with respect to characteristic C

An overall average measure of similarity was calculated for each pair of faculty members by summing the individual similarity measures across the k respondents and dividing the total by the number of respondents as follows:

$$\bar{S}_{ij} = \frac{\sum_{k=1}^{N_k} (S_{ij})_k}{N_k}$$

where N_k=the number of respondents

Twenty seven faculty pairs were rated which resulted in a 27 x 27 matrix of similarity values $\bar{S}_{ij}$. There are (N)(N-1)/2 = 27(27-1)/2 = 351 unique similarity values in the matrix. Using the similarity values matrix, ordinal levels of measurement, the dimensionality of the ideal professor characteristics was then extracted through the non-metric multidimensional scaling computer program (Kruskal and Carmone, 1969). This procedure was accomplished using the data from all 43 respondents. A similar procedure was employed to ascertain the dimensionality of the ideal professor characteristics as identified by each subgroup of respondents, i.e., administrators, faculty, staff and students.

RESULTS

Preliminary analysis of all the data revealed the most salient characteristics listed by the respondents (see Table 1). Most prominent were instruction, service, interpersonal relations, personal characteristics and research orientation. Obviously the specific language of the characteristic differed from respondent to respondent. Since these characteristics were given numerical weight, it was possible to determine the importance the respondents attached to the various characteristics. Teaching received .53 of the emphasis; service received .20; personal qualities .11; interpersonal relations .09; and research skills .06.

Using the multidimensional scaling program, a series of iterations was performed on the data beginning with a five dimensional solution down to a one dimensional solution. The stress values were obtained and graphed to determine the best fit of the data; a noticeable "elbow" occurred at two dimensions which suggested a two dimensional solution to the problem. Using the two dimensional solution, the final configuration of points was graped for the 26 faculty members and the ideal professor (see figure 1). The intercept of the two dimensions represented the perceived average of all individuals rated by the respondents. The graph represents the ranked distance (d_{ij}) between professors i and j. This distance corresponds to the similarity index $\overline{S}_{ij}$ but transformed into a two dimensional array.

The two dimensions were then labeled through a procedure similar to that used in naming factors in a factor analysis, i.e., one examines the variables loading heavily on the factor and rationally/intuitively labels the dimension. In this example, the variables are faculty members. The weights assigned by the respondents were heavily concentrated in the areas of instruction and service lending credence to the two dimensional solution and the naming of the dimensions. In addition, the two dimensions were also found in the Subkoviak and Levin (1974) study.

The weights assigned by each subgroup in determining the relevant characteristics are presented in table 2. Visual inspection of the weights reveals specific discrepancies across categories of staff, but general consistency in identifying and weighting domains.

The multidimensional scaling program was similarly applied to the data from each subgroup. Examination of the stress values for administrators, faculty and staff indicated a distinct elbow at two dimensions. Plotting the two dimensional arrays consistently yielded the labels of instruction and service

for each group. The stress values obtained from the student data indicated a distinct elbow at four dimensions. The two primary dimensions were identified as instruction and service and for the sake of comparability across groups the two dimensional solution was substituted.

The resulting two dimensional plot for each group can be found in figures 2, 3, 4 and 5. These figures graphically display the relative positions of the 27 professors as perceived by administrators, faculty, staff and students. Individual faculty members are consistently alphabetized across plots; the ideal professor is indicated by an asterisk.

DISCUSSION

Through the use of this "open-ended" method of data collection and the application of non-metric multidimensional scaling, a unique characterization of the ideal professor was obtained. In addition, the positions of a specific set of faculty members were determined in relation to the ideal and each other; these projections were obtained from administrators, faculty, staff, students and a composite. Each plotting represents a direct comparison of each faculty member with each other faculty member and the ideal as perceived by the group of responders.

Two specific dimensions were consistently identified--instruction and service--across all groups of respondents. Instruction received a very heavy emphasis and service received slightly less emphasis. Other characteristics of the ideal professor did not receive sufficient emphasis to allow for meaningful interpretation.

As one examines the location of the ideal professor across groups, there is an interesting finding; the perception of the ideal differs considerably across groups, even though there is basic agreement on the number of dimensions and the characteristics on these dimensions. Note in particular the large discrepancy between the perceptions of the staff and those of administrators and faculty.

Everyone agrees that the ideal is above average on the instructional dimension (in varying degrees) and yet the staff see the ideal being heavily involved in the service delivery activities while other groups see the ideal as being less involved in service delivery.

Another interesting finding is that perceptions about individual faculty members relative to each other and the ideal differ considerably across groups, yet there is consistency within groups as indicated by the stress values. For example, individual W is placed in the upper right quadrant by administrators and staff (in markedly dissimilar places in the quadrant) the lower right quadrant by faculty and the lower left quadrant by students. On the other hand, individual Y is consistently placed close to the ideal for all groups except staff.

In general, the data seem to indicate that subgroups of personnel are operating from what on the surface appears to be a consistent frame of reference, e.g., number of dimensions and characteristics of the dimensions, but they operationalize the characteristics somewhat differently. The perceptions of individuals and the ideal are not consistent across groups. These discrepancies may result in potential role expectations which may go unfulfilled or over fulfilled, as the case may be. Without resolution of these discrepancies, program personnel may be using the same language to convey different meanings. At a minimum, this will lead to miscommunication and probable lack of efficiency. It could also affect the morale of involved personnel. There is even the possibility of internal conflict.

These data confirmed two of the three dimensions identified by Subkoviak and Levin (1974) and Wilson, et. al. (1973) but did not elicit a significant third dimension (research) as found in the previous works. This is not surprising as the clearly delineated two fold thrust of the program under study is instruction with the delivery of service as the vehicle for the instruction.

There is very little emphasis upon research in the program. If this study were conducted in other settings, t e results of course may be different. For instance, other organizations may be more research oriented so that the identified characteristics would be more heavily oriented toward research and publications and/or other factors while characteristics as identified in this study might receive considerably less emphasis.

This study has demonstrated the feasibility and applicability of using a non-metric multidimensional scaling technique to obtain responses to a set of stimuli using a series of non-common tools (characteristics and scales). It was illustrated that this procedure can be employed with diverse groups of respondents. Possible applications are as follows: (1) The results could be used to determine common criteria for input into personnel evaluation by group consensus. (2) By utilizing the common criteria program decision makers could modify individual behaviors to be in line with expectations or to modify the expectations to be in line with the individual's performance. (3) These data could potentially be used for feedback to the individual relative to other's perceptions of the individual's performance. (4) These data might potentially be used for salary negotiations, promotion, tenure, etc. (5) (5) Programmatic emphasis could be increased, modified, etc., based upon the outcome of these data. (6) These data could be used as an evaluative device in identifying consistency/inconsistency of perceptions on programmatic functioning across levels of staff.

Table 1

Characterization of the Ideal Professor
and Corresponding Assigned Weights

Domain	Typical Characteristics	Weight
Teaching	Knowledge of subject matter Ability to communicate knowledge Good course organization Ability to interest and motivate students	.53
Service	Service to clients Clinical skills Interdisciplinary skills Skillful and mature application of skills	.20
Personal Qualities	Intelligence Dedication Integrity Maturity	.11
Interpersonal Relations Skills	Interpersonal management skills Ability to relate to others Flexibility Approachability	.09
Research Skills	Research Publication Generates research ideas	.06

Table 2

Weights Assigned to Ideal Professor Characteristics by Levels of Program Staff

Domains	Total Group N=43	Administrators N=5	Faculty N=15	Staff N=15	Students N=8
Teaching	.53	.59	.52	.55	.48
Service	.20	.16	.16	.21	.24
Interpersonnel Relations	.11	00	.12	.07	.12
Personal Qualities	.09	.12	.15	.09	.06
Research	.06	.07	.05	.06	.08

Figure 1

Two Dimensional Array of Faculty and Ideal
Professor Characterization as Perceived by Respondents

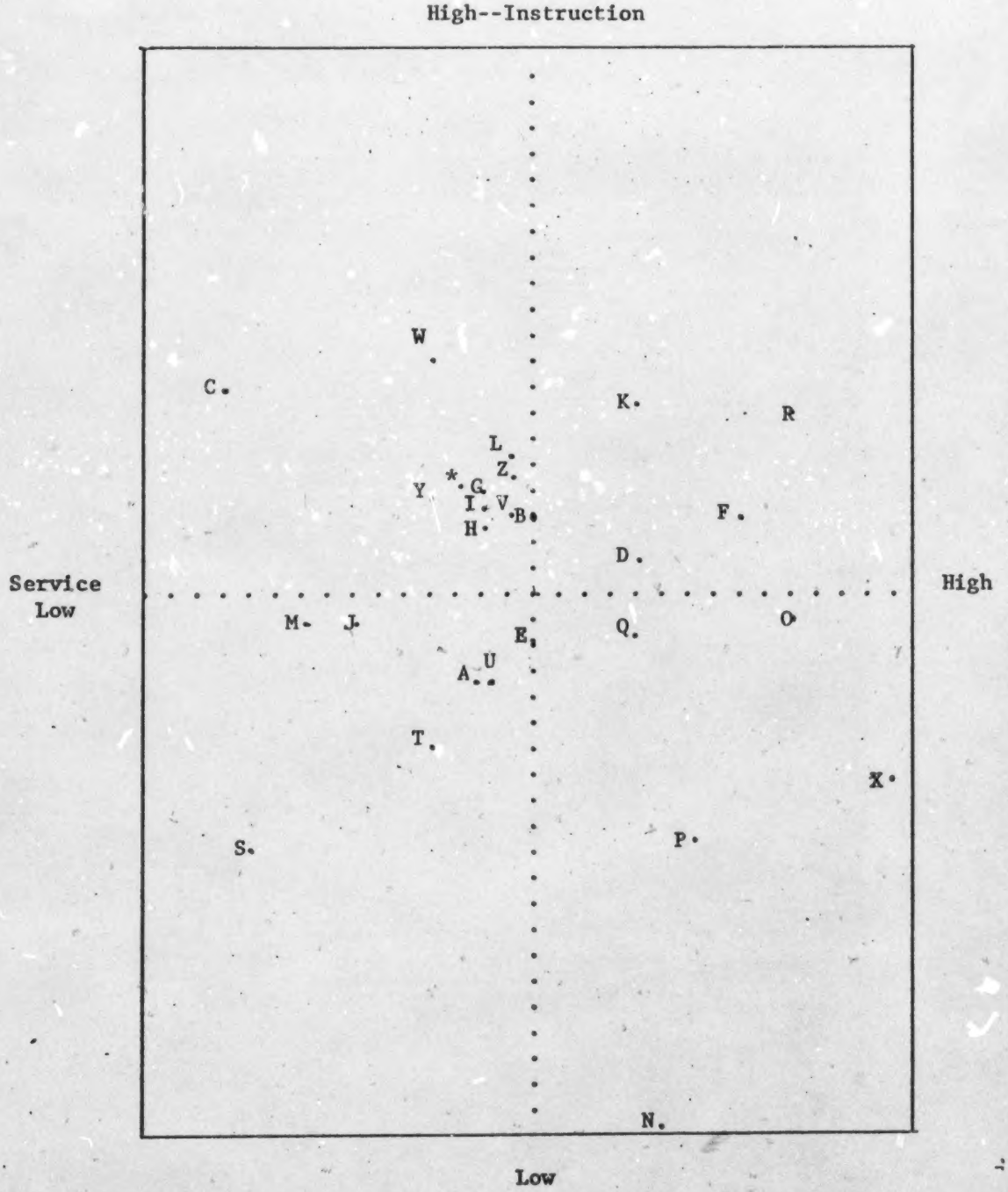


Figure 2

Two Dimensional Array of Faculty and Ideal
Professor Characterization as Perceived by Administrators

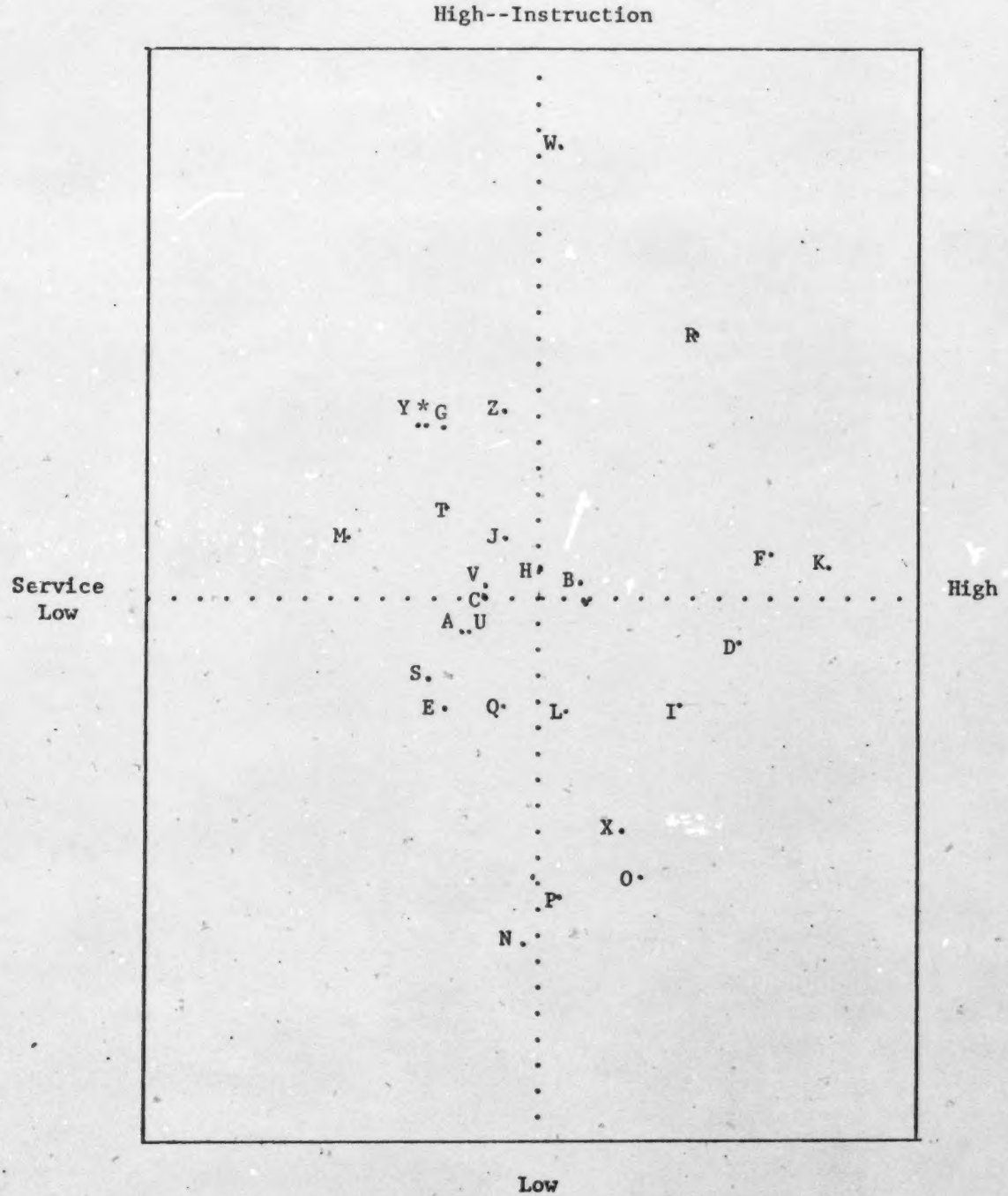


Figure 3

Two Dimensional Array of Faculty and Ideal Professor Characterization as Perceived by Faculty

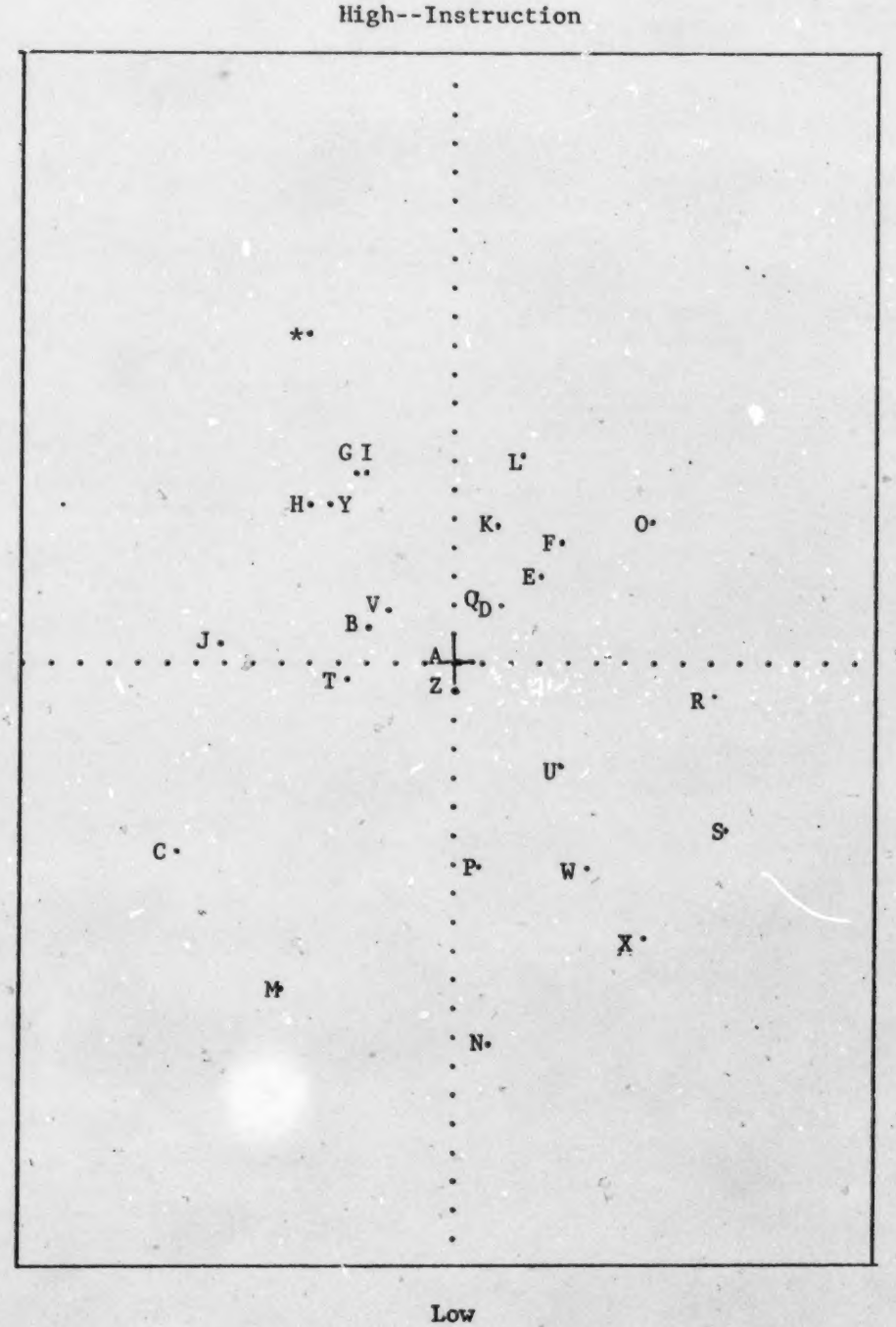


Figure 4

Two Dimensional Array of Faculty and Ideal Professor Characterization as Perceived by Staff

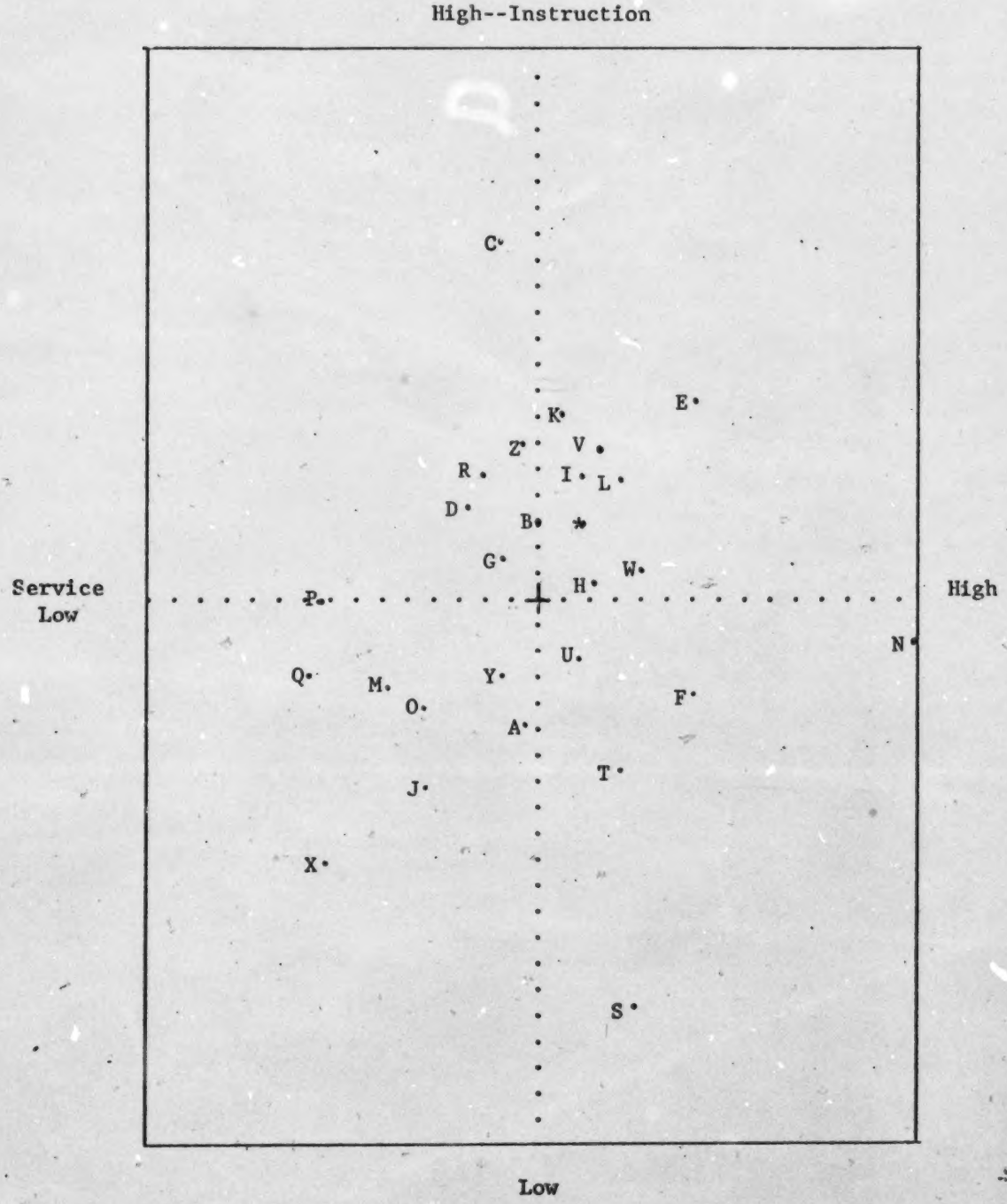
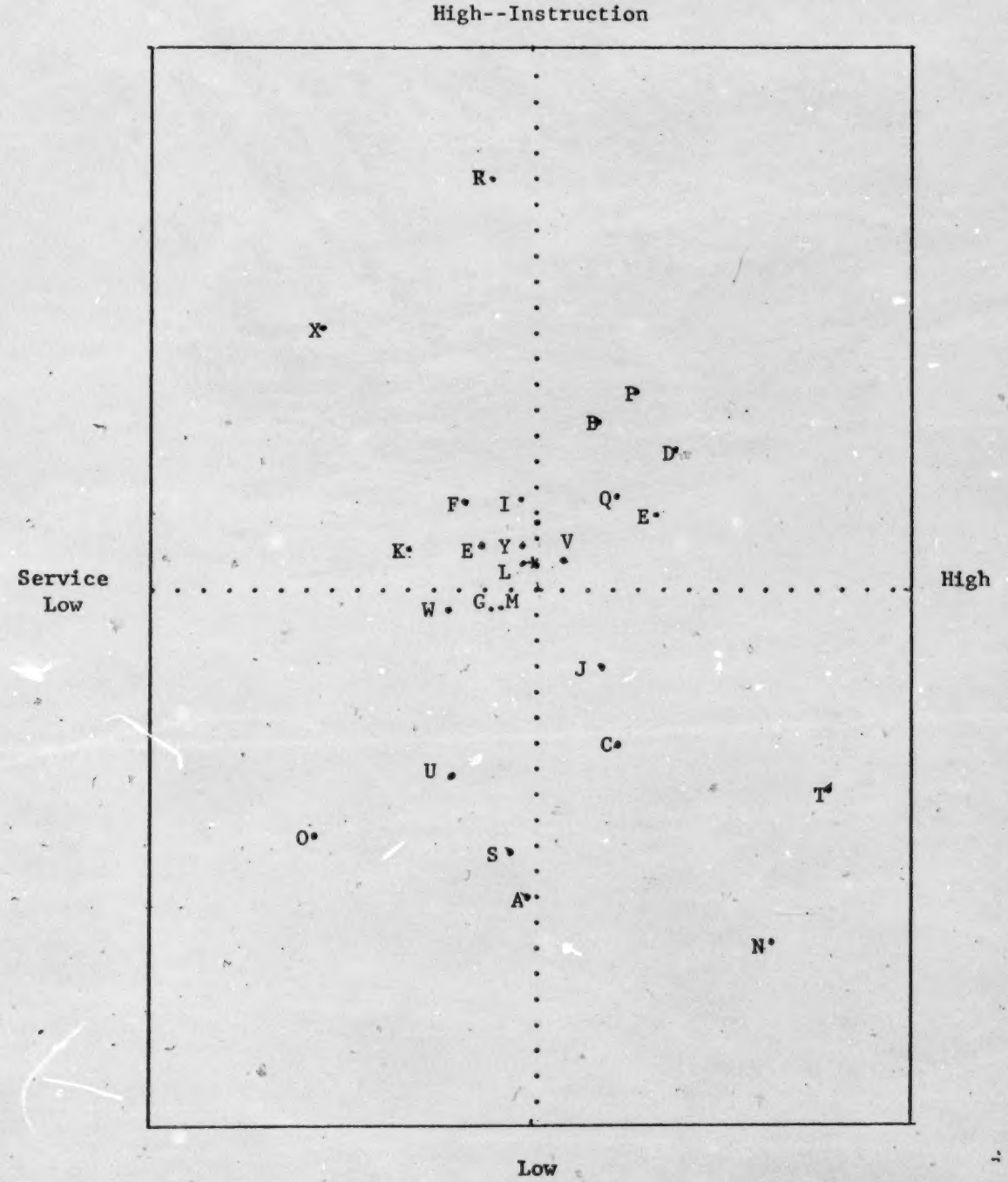


Figure 5

Two Dimensional Array of Faculty and Ideal Professor Characterization as Perceived by Students



BIBLIOGRAPHY

1. Astin, A., Lee, C. "Current Practices in the Evaluation and Training of College Teachers." Education Record. 47(3), 1966.

2. Carroll, J.D., Chang, J.J. "A general index of nonlinear correlation and its application to the interpretation of multidimensional scaling solutions. American Psychologist, Vol. 19, 1964.

3. Carroll, J.D. Individual Differences and Multidimensional Scaling. In Shepard, Ronney and Nerlane (Eds) Multidimensional Scaling, Vol. 1. Theory New York. Seminar Press, 1972.

4. Costin, F., Greenough, W., Menages, R. "Student Ratings of College Teaching: Reliability, Validity and Usefulness." Review of Educational Research. Vol. 41, 1971.

5. Kruskal, J.B. "Multidimensional Scaling by Optimizing Goodness of Fit to a Nonmetric Hypothesis." Psychometrika. 29, 1964.

6. Kruskal, J.B. "Nonmetric Multidimensional Scaling: A Numerical Method." Psychometrika. 29, 1964.

Kruskal, J.B., Carmone, F. "How to Use Multidimensional Scale and Other Useful Information." Unpublished paper, Bell Laboratories, 1969.

7. Shepard, R. "The Analysis of Proximities: Multidimensional Scaling with an Unknown Distance Function. II" Psychometrika. 27, 1962.

8. Subkoviak, M., Levin, J. "Determining the Characteristics of the Ideal Professor: An Alternative Approach." Journal of Educational Measurement. Vol. 11, No. 4, Winter 1974.

9. Wilson, R., Dienst, E., Watson, N. "Characteristics of Effective College Teachers as Perceived by Their Colleagues." Journal of Educational Measurement. Vol. 10, 1973.

10. Wish, M., Deutsch, M. Biener, L. "Differences in Conceptual Structures of Nations: An Exploratory Study." Journal of Personality and Social Psychology. 16, 1973.